THE CRUSHED STONE JOURNAL

Official Publication
The National Crushed Stone Association

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A Message to Foremen

Profitless Orders

APRIL, 1930

WHY HAVE LOSSES

Poor Grading—High Overhead—Troubles

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Rock-Cut Stone Company	Ballina, Madison Co., N. Y.
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Rock-Cut Stone Company	Lacona, N. Y.
Rock-Cut Stone Company	Watertown, N. Y.
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Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
BUFFALO Crushed Stone Company	Buffalo, N. Y.
Federal Crushed Stone Company	Cheektowaga, N. Y.
Genesee Stone Products Company	Stafford, N. Y.
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General Crushed Stone Company	North LeRoy, N. Y.
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Wagner Quarries	Castalia, Ohio
Dolomite, Inc.	Maple Grove, Ohio
Herzog and Sons	Forest, Ohio
Ohio Blue Limestone	Marion, Ohio
National Lime & Stone Co.	Spore, Ohio
National Lime & Stone Co.	Carey, Ohio
National Lime & Stone Co.	Lewisburg, Ohio
National Lime & Stone Co.	Bluffton, Ohio
Belle Center Stone Co.	Belle Center, Ohio
Higgins Stone Company	Bellevue, Ohio
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Lake Erie Limestone Company	Lowellville, Ohio
Lake Erie Limestone Company	Hillsville, Pa.
Lima Stone Company	Lima, Ohio
Spencer Stone Company	Spencerville, Ohio
Union Limestone Company	Youngstown, Ohio
Ohio Marble Company	Piqua, Ohio
C. C. Beam	Melvin, Ohio
Rock Products Company	Toledo, Ohio
France Stone Company	Holland, Ohio
France Stone Company	Monroe, Mich.
Swint Stone Company	Fremont, Ohio
J. E. Baker Company	Bainbridge, Lancaster Co., Pa.
J. E. Baker Company	White Hall, Baltimore, Md.
New Castle Lime & Stone Company	New Castle, Pa.
New Castle Lime & Stone Company	Dunbar, Pa.
Lehigh Stone Company	Ormrod, Pa.
Stowe Trap Rock Company	Pottstown, Pa.
Carbon Limestone Company	Hillsville, Pa.
Blue Stone Quarry Company	Gwynedd Valley, Pa.
Whiterock Quarries	Pleasant Gap, Pa.
Connecticut Quarries Company	Rocky Hill, Conn.
New Haven Trap Rock Company	New Haven, Conn.
Edward Balf Company	Hartford, Conn.
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West Roxbury Trap Rock Company	West Roxbury, Mass.
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Gager Lime Company	Sherwood, Tenn.
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CANADA

J. A. Bourbonnais	Vaudreuil, Que.
Canada Crushed Stone Corp.	Puslinch, Ont.
Coast Quarries	Vancouver, B. C.
Dufferin Construction Company	Innerkip, Ont.
Gordon Crushed Stone Company	Hagersville, Ont.
Thomas Langton Crushed Stone	Coldwater, Ont.
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Puslinch Quarries, Ltd.	Puslinch, Ont.
Quinn Stone and Ore Company	Ft. William, Ont.
Rigand Granite Products Company	Rigand, Que.
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40 PEARL STREET

BUFFALO, N. Y.

WHEN CLAMSHELL BUCKETS ARE UNDER CONSIDERATION

IT PAYS TO DEAL WITH BLAW-KNOX

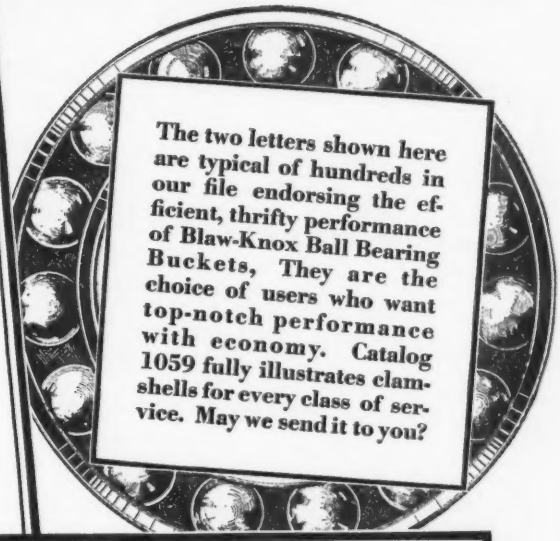
November 27, 1929

Blaw-Knox Company
Box 915
Pittsburgh, Pa.

Gentlemen:

We have your favor of the 25th in regard to the Blaw-Knox buckets we bought from you. We consider the Blaw-Knox the best bucket by far on today's market. It not only is a better digger, which is the chief use of a bucket, but outlasts anything we have yet had. We would not consider any other bucket for future purchases.

Yours very faithfully,
STANDARD WHOLESALE PHOSPHATE & ACID WORKS, Inc.
(Signed) George A. Whiting,
PRESIDENT



The two letters shown here are typical of hundreds in our file endorsing the efficient, thrifty performance of Blaw-Knox Ball Bearing Buckets, They are the choice of users who want top-notch performance with economy. Catalog 1059 fully illustrates clamshells for every class of service. May we send it to you?

November 27th, 1929

Blaw-Knox Company,
P. O. Box No. 915,
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Gentlemen:

We have had one of your extra wide re-handling buckets of 2 cubic yards capacity for about 6 months. It has given every indication of handling more material during the course of a day than any other bucket we have ever used, picking up more than 2 yards at every bite.

It therefore gives us pleasure to heartily recommend this bucket as being most economical and efficient.

You may give anyone in the market for buckets our whole hearty indorsement.

Yours very truly,
SUPER CONCRETE CORP.
(Signed) H. B. Graham,
VICE-PRES.

BLAW-KNOX COMPANY
2053 Farmers Bank Building, Pittsburgh, Pa.
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BLAW-KNOX

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BUILD A REPUTATION

for properly graded stone or slag---

IT'S PROFITABLE!

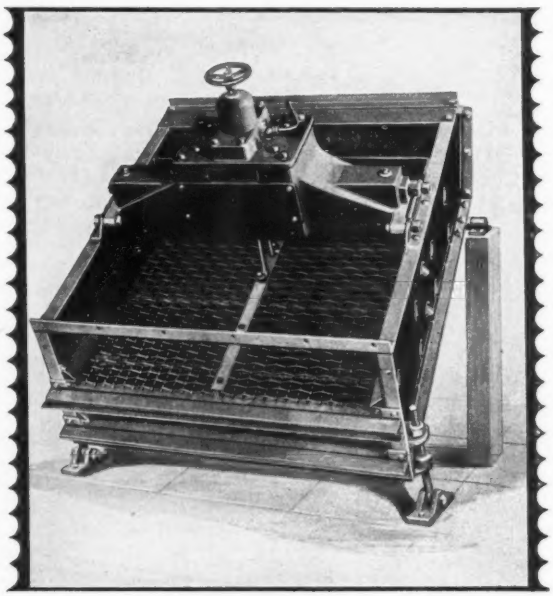
BUILD a reputation for properly graded slag or crushed stone and you are on the road to increased business and increased profits.

Stone and slag buyers are becoming more and more exacting in their demands, and, if you are equipped to produce a clean, well-graded product, you can get and hold their business.

The largest operators have found it decidedly profitable to screen with the Hum-mer—they have found that "Hum-mer-screened" products are easier to sell and bring higher prices.

The Hum-mer screening process will enable you to meet the most rigid size specifications, at a low cost per ton.

If interested, send for the book, "Screening for Profit."



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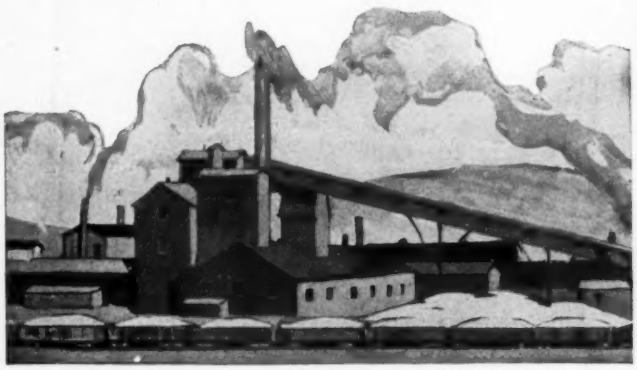
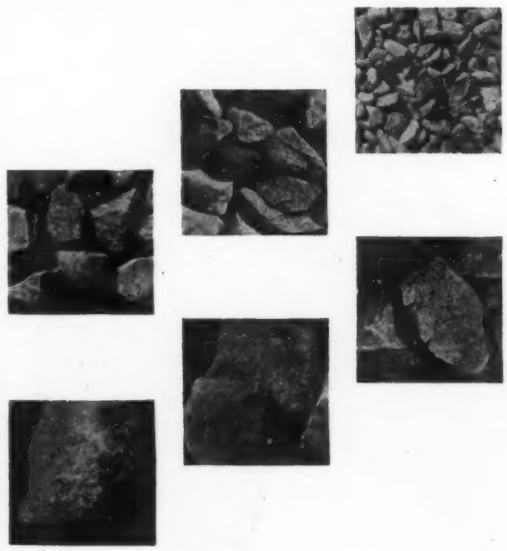
Manufacturers of **Woven Wire Screens and Screening Equipment**





HUM-MER *Electric* SCREEN

The CRUSHED STONE JOURNAL

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Tests of Pavement Concrete Being Conducted by the U. S. Bureau of Public Roads[1]

BY F. H. JACKSON,

Senior Engineer of Tests, U. S. Bureau of Public Roads

I HAVE been quite impressed during this meeting of the National Crushed Stone Association with the interest which is being manifested by your members in the question of aggregates for road construction. It seemed to be the central theme of Mr. Goldbeck's talk yesterday, and at the group meeting on sales problems the question of concrete for highways kept bobbing up continuously. I really don't know whether to be alarmed or gratified at the situation. I don't know whether the highway engineers are so bedeviling you with new and multiplied specifications for materials that you can't keep up with them, or whether it is simply evidence that the highway engineers are keeping abreast of developments in the utilization of concrete in road construction, possibly with more energy than their brothers in other lines of concrete work.

Tests Indicate that Requirements as to Durability of Aggregate may be Varied with Class of Concrete

I have not prepared a formal paper to give you this morning, but with your permission I shall discuss informally, first, some of the tests which we are conducting or have recently conducted at the Bureau with the idea of determining how best to utilize aggregates in concrete; second, some of the trends among the various states in specifications for concrete for roads, and the attitude of the Bureau of Public Roads relative to the various types of specifications; and third, to discuss a specification which the Bureau is recommending to highway departments at the present time, with the object of utilizing information obtained within the last few years as a result of research by the Bureau and other agencies.

In studying concrete for roads, we have first to ask ourselves the question: What are the essential characteristics of concrete for this type of construction? And we can immediately answer, first, durability or permanence, and second, strength. I am going to talk for just a moment about tests we have been making to determine how aggregates affect the durability of concrete, and also how they affect the strength. Down at Washington we have had under way for some time a series of tests with a large variety of aggregates to determine the effect of type and character of aggregate (crushed stone, gravel and blast furnace slag) on the permanence and durability of concrete.

In connection with freezing and thawing tests made on concrete of a variety of mixtures containing the various aggregates, we have been making freezing and thawing tests on the aggregates themselves as the best measure of durability we know of at the present time. The sodium sulphate test for soundness of aggregates is also made and this test was discussed somewhat by Mr. Goldbeck yesterday.

We have not yet published the results of any of these tests and I think you may be interested in some of the trends which seem to be coming to light as the tests progress. Among other things, we are finding that in the leaner mixtures where, for instance, the water cement ratio is greater than one, the criterion for durability of the concrete is the durability of the mortar and not that of the coarse aggregate. In other words, in concretes such as the so-called ordinary class-B and class-C concretes which are used in railroad and bridge structures, we find that the mix is usually so lean that the first failure is in the mortar. Therefore, in such types of concrete, it is not as important that we have a coarse aggregate with such high durability as is necessary for other types of concrete.

On the other hand considering pavement concrete, we find that the durability of the aggregate may in-

[1] Presented at the Thirteenth Annual Convention of the National Crushed Stone Association, Cincinnati, Ohio, January 22, 1930.

fluence the durability of the concrete. Certain types of aggregates, in a rich mixture, are apparently failing and in failing they cause the concrete to fail. These facts suggest that in judging the durability of an aggregate we should take into consideration the class of concrete in which it is to be used.

I want to indorse what Mr. Goldbeck has said about the sodium sulphate test. The Bureau has considered the possibility of this test affording preliminary information regarding the durability of stone as concrete aggregate. We know that tests have shown that there are many stones which fail rapidly in the sodium sulphate tests but which do not fail in concrete.

Largely because of the attention directed to this test by the work of Mr. Goldbeck, the Committee on Materials of the American Association of State Highway Officials expects to study the test further with the idea of revising the technique so that at least check results can be obtained in various laboratories. After that is done, there will still remain the matter of interpreting the results of the test in terms of actual performance of concrete in structures.

Inherent Characteristics of Aggregate Affect the Strength of Concrete

The other essential characteristic of concrete is strength and for concrete roads, it is now generally agreed that the essential thing is flexural or transverse strength rather than compressive strength. Not that compressive strength is not important, but the critical stress, insofar as loads coming upon the pavement is concerned, is the flexural or transverse strength, as has been pointed out by Mr. Goldbeck.

The Bureau has just completed quite an extensive series of tests to determine how the character and grading of the coarse aggregate affects the flexural strength of concrete. It has been very interesting to note the wide range in strength which is obtained, due entirely to the character of the aggregate. That is, with every other factor constant, the character of the material itself—and by character I mean the inherent characteristics of the stone or gravel itself rather than its grading—apparently affects the strength of the concrete to a large extent. Just what inherent characteristics of the aggregate influence the flexural strength has not yet been established. I am inclined to think that the surface texture of the stone affects the bond between the surface of the stone and the mortar, and thus influences the strength of the concrete. Aside from these tests we know from other tests in our laboratory and those of other agencies that you can easily get a variation in flexural strength by varying aggregates. In some cases the strength variation has been equivalent to the variation which would be obtained by changing the water-cement ratio about two-tenths and anyone who is familiar with the water-cement ratio law as developed by the Portland Cement Association and others knows the variation in strength such a change in the water-cement ratio will make.

It is evident that in studying concrete for pavements we must consider the aggregates. We can not simply say that if we use six gallons of water per sack of cement a certain strength will result. That won't do. We may get that strength or we may get a strength 20 per cent higher or lower, depending upon the aggregate. The characteristics of the aggregate very markedly influence the strength and therefore should be taken into consideration.

I do not have in mind that aggregates can be classed by types such as limestone, trap, gravel, etc., so as to give information on this point but rather that the characteristics of the particular aggregate to be used must be considered in arriving at a definite idea of the strength which will be obtained.

In the tests to which I refer, we found that two of the coarse aggregates giving the highest strengths were gravels. Likewise two crushed stone aggregates were in the same group. The fact that the aggregate in crushed stone as opposed to gravel, or vice versa does not indicate in any way the relative strength.

Tests being made to Determine Maximum Amount of Coarse Aggregate which may be used in Concrete

I wish to say a word about a series of tests which we have under way at Arlington, Virginia, at the present time. We have built about a half-mile of concrete pavement, nine feet wide, using full-sized paving equipment, a 27-E paver and a regular batching plant, to determine the proper or the limiting amount of coarse aggregates which may be used in a concrete paving mix. We placed and finished this piece of pavement under usual construction practices. We at the Bureau have thought that if the coarse aggregate is properly controlled by separating it into sizes and each size measured separately that it might be possible to use a larger amount of coarse aggregates in the concrete than has been thought possible by many highway engineers. We feel that this will result in economy in a great many cases and also that the quality of the concrete will be improved. It seems reasonable to sup-

pose that, given a sound coarse aggregate, the larger the amount of coarse aggregate in the concrete the more durable and permanent the concrete will be, provided it can be mixed and placed without honey-combing and segregation.

The tests are being run on a number of sections with crushed stone and gravel, and some sections with slag, using three sizes of coarse aggregate (in each batch) combined with sand and cement in a constant proportion. The proportion of coarse aggregate was varied from three and a half parts by volume to one of cement up to the limit of workability, judging workability by the ability of the finishing machine to produce a satisfactory finish.

Tests will be made on cores drilled from the pavement, on beams cast alongside the pavement, and also on sections of the pavement itself. The latter test sections will be 2½ feet wide and 5 feet long and will be tested for transverse strength. Such tests should indicate the uniformity of the concrete in various parts of the slab for various mixtures of coarse aggregate. We hope also to obtain data which will help in evaluating the information which will be obtained from the core tests and beam tests.

At present we do not know exactly what those tests mean in terms of actual strength of the pavement and we hope to obtain information along that line during the coming summer when these pavement slabs will be tested.

New Specification for Concrete Proposed by Bureau of Public Roads

I want to say a word about the matter of proportioning. As you all know, the common method of proportioning concrete for pavements as well as other types of structure has been the so-called arbitrary volumetric proportion such as 1:2:4, etc. There is a tendency to correct that situation at the present time by the introduction of so-called designed mixes. The Bureau is sponsoring and encouraging the use of designed mixes in order to obtain concrete of specified strength rather than the uncertain strength resulting from specified proportions. The only merit in the old system, in my estimation, was its simplicity. It was always easy to say 1:2:4 concrete, but it got you nowhere in the matter of uniformity. We all know the great range in quality of concrete under that type of specification.

The ultimate specification of the type which we advocate, we think, will result in obtaining concrete of a given modulus of rupture or flexural strength. However, we do not feel that we can hurdle immediately to that ultimate specification and for that reason we are encouraging the state highway departments to take the initial steps in that direction by revising their specifications so that for a given service the concrete will have exactly the same amount of cement, regardless of the type and character of the aggregates used. For example a specification for concrete pavement will read: "The concrete shall contain six bags of cement per cubic yard of concrete, etc." That will accomplish a good deal. It will help to do away with the troubles which we have had as regards non-uniformity though it does not remove all of the trouble.

That method is popular with the engineer because it is easy to adminster. It is quite easy to check up on the contractor and see if he is using a definite amount of cement per cubic yard. It is also popular with contractors because they are able to estimate more closely when they know the exact amount of cement required per cubic yard of concrete.

I want to conclude with a brief statement relative to the specification proposed by the bureau and circulated among the states with the idea that they will study it and possibly see fit to apply it to concrete pavement work. This is a designed strength specification and I want to read just the paragraph dealing with the composition of the concrete so that you will understand the basis for the specification.

"Composition of Concrete"

"The proportions of cement, aggregates, and water will be fixed by the Department on the basis of laboratory tests, using aggregates from the same sources and the same gradings as will be employed on the work. The mixture will be designed to produce concrete of the required workability, having a modulus of rupture of at least ..... pounds per square inch at 28 days when tested by means of standard laboratory methods."

I also want to read a note which will accompany this specification as information to any contractor who may care to bid under it.

"Note to Bidders"

"The Department (meaning the State Highway Department) will furnish prospective bidders, upon request, the proportions which will be required for all aggregates from such regular established commercial sources as are available for use on the project. This information will also include the grading requirements which apply in each case."

In other words before any job is let the Department will obtain samples from the available sources of aggregate and will test these samples in concrete, possi-

bly along the lines discussed by Mr. Goldbeck (the water-cement ratio trial method) to determine the proportions required in each case to produce concrete of definite quality.

This is not so theoretical as it sounds. I am confident that it can be done. There are a relatively small number of aggregates available for any given job, and there seems to be no reason why the states can not obtain information with regard to them in advance. For any given source of supply the information must be obtained only once as we wish to determine the effect of the characteristics of the aggregate itself on the strength of concrete and the characteristics do not change through many years of operation. This is the basis of this specification.

The specification also contains the usual requirements for fine and coarse aggregates, largely following the latest specification of the American Concrete Institute and the American Society for Testing Materials. A rather interesting feature is the requirement that where the maximum size of coarse aggregate exceeds the one and a half square inch opening, it shall be furnished in two separate sizes.

I want to conclude with just a little talk on this requirement. I thoroughly believe that the next development in improvement of the quality of concrete will be the adoption of the practice of furnishing the coarse aggregate in at least two separate sizes. I can see no reason, from the producer's standpoint, why such a practice would not work out entirely satisfactory. The producer of crushed stone who produces the material in separate sizes at the plant is frequently faced with the necessity, under present practice, of attempting to blend the sizes in a car or barge in order to meet some specific gradation requirements of the state highway department. Under the proposed system, he would ship to the job separately the required quantity of each size specified.

I also want to call attention to the fact that such a requirement will not necessarily limit the producer to furnishing exactly the same proportion of the different sizes under all conditions. I do not believe that it is necessary to maintain an absolutely constant grading of an aggregate under all conditions in order to obtain good results. Having established the grading and having designed the concrete upon that basis, I believe the important thing is to be assured the grading will not vary throughout the construction of that particular job. The grading may vary with conditions in different states and with different seasons of the year, depending upon the demand for aggregates of certain sizes for other purposes. But having once decided what grading should be used for a given job, uniformity is of paramount importance and I think the only way we can possibly obtain it is through the specification for separate sizes of aggregates delivered on the job as such.

Discussion of Suggested Specifications for "Designed-Mix" Concrete for Pavements

The accompanying specification has been prepared by the Division of Tests in an endeavor to provide a method of utilizing in actual practice the various principles governing the design of concrete paving mixtures which have been established as the result of research in the Bureau's laboratories and elsewhere.

These governing principles may be stated briefly as follows:

1. That flexural strength is the most important strength characteristic of pavement concrete and that a concrete paving mixture should therefore be designed to meet a definite flexural strength requirement rather than a definite crushing strength requirement.

2. That so many factors affect the flexural strength of concrete that the strength which will be obtained by the use of any given combination of materials can not be determined by any so-called calculation method, such as the fineness-modulus method, but must be determined by actual trial in the laboratory.

3. That, *for any given combination of materials,* the flexural as well as the crushing strength of concrete is governed by the ratio of water to cement in the mix, substantially in accordance with the water-cement-ratio law. This fact makes it possible to design concrete paving mixtures by the so-called "water-cement-ratio trial-method" as described in *Public Roads* for August, 1928.

Explanation of Proposed Specification

The use of this type of specification presupposes that the department will have available for the use of prospective bidders the proportions by weight as well as the grading requirements for each combination of aggregates commercially available for the job under consideration. By "commercially" available is meant those sources of supply within a practical shipping radius. This may at first thought appear impractical due to the large number of tests involved. It should be possible, however, for any state desiring to use this type of specification to determine in advance the proper proportions for each of the regular commercial

sources of supply available. Such tests once made would not have to be repeated every time a given combination of materials was used but would be part of the permanent available records of the department subject only to modification when the character of either one or both of the materials in the combination changed. Investigations to determine the proportions required for various materials could in many states be made part of a winter research program.

Similar information from local sources of supply would be somewhat more difficult to obtain. However, a state depending to any considerable extent upon local materials for concrete aggregates should, and many of them already do, conduct material surveys well in advance of construction. The necessary tests could in such cases be made on samples of materials as fast as obtained and the information filed for reference when improvements are about to be made.

The procedure set up in the accompanying specification appears to be the most practical method of recognizing that different materials may have to be used in different proportions to obtain the same strength and that we must therefore design for a given strength and adjust our proportions accordingly. The method evaluates competing aggregates in a fair and rational manner; that is, in terms of their ability to make concrete of definite strength. This after all is what we are interested in—the matter of proportions being only a means to an end. Under this system, the bidder knows just how much he is justified in paying for each available aggregate. He may determine, for instance, whether he will be justified in paying a higher price for a shipped-in aggregate, which includes freight, than for a local material of poorer quality and consequently requiring more cement. No aggregate will be unfairly penalized and no aggregate will be given an unfair advantage.

As an illustration of how this type of specification might work out in practice, a hypothetical case will be cited.

Let us suppose that a state advertise for bids to construct a certain piece of concrete pavement, and let us further assume that for this job coarse aggregates from three sources are available. Let these be identified as aggregates A, B and C. Also, that there are two fine aggregates available, D and E. All of these materials, it will be assumed, meet the basic requirements of the specification. The state has tested samples obtained from each of these sources in concrete and has available for the use of bidders a tabulation of proportions required for the combinations available together with the corresponding quantities per cubic yard of concrete. This information might go to bidders in tabular form somewhat as shown below, except that the various sources of supply would, of course, be identified by name and location instead of by letter.

Combination	Quantities per Cubic Yard			Proportions		
	Cement	Sand	Coarse Aggregate	Cement	Sand	Coarse Aggregate
	Pounds	*Pounds*	*Pounds*	*Bags*	*Tons*	*Tons*
A and D	94	182	371	6.4	.58	1.19
A and E	94	139	349	6.9	.49	1.19
B and D	94	225	415	5.4	.60	1.12
B and E	94	178	396	5.8	.51	1.14
C and E	94	161	374	6.1	.49	1.14
C and E	94	119	353	6.6	.40	1.16

The above weights and quantities while not actually derived from specific laboratory tests represent no greater range in proportions for concrete designed for a specified strength than would be found necessary in many sections where aggregates of variable character are available. The values are given merely to indicate the form which the information might take, as well as to illustrate reasonable variations in quantities which might easily be encountered. In an actual case the grading requirements which would apply for each aggregate would also be furnished. This information is necessary in order that material dealers may quote intelligently on request of bidders.

It will be observed from the above table that there is a maximum difference of 1.5 bags of cement per cubic yard, depending entirely upon the aggregates selected. It will be noted also that sand D is sufficiently higher in quality to justify a reduction in the cement factor of about 0.5 bags in the combinations in which it is used. Sand E may be assumed to be a somewhat finer sand locally available, whereas sand D has to be shipped in. Likewise coarse aggregate B is seen to be much higher in quality than either A or C, the differential between A and B being 1.0 bag while that between B and C is about 0.7 bag.

With this information, together with the prices quoted on the various materials, before him, each bidder is in a position to prepare an intelligent bid on the work, in so far as the cost of the materials is concerned. He knows just how much cement, sand, and coarse aggregate he will have to buy for any combination he may select as well as the unit costs in each case delivered. It is obvious that, other things being equal, he will base his bid on the combination showing the lowest total cost for all materials, including the cement.

There is no guesswork about it, and for this reason closer bids and therefore lower prices should result.

Portland Cement

It is of course realized that the quality of the Portland cement used in the concrete may have as great or greater effect on strength as the type of aggregate.

It is, however, not quite so simple to closely control the cement on a public-works job, especially where the contractor buys his own cement. Attempts to control the quality of the cement other than to require that it pass the American Society for Testing Materials Requirements are seldom made. Some procedure which would enable the department to designate not only the brand but the actual mill from which the cement is to be shipped would be necessary to accomplish more than this.

Closer control may be obtained where the state furnishes the cement. In such a case, however, the scheme outlined above, which requires varying amounts of cement, depending on the aggregates used, would not operate unless some method of charging the contractor for the amount of cement he used was adopted. Such a scheme was tried by at least one state last year.

Bids under the accompanying type of specification would be taken in the usual manner; that is, price per square yard of pavement in place. Upon notice of award, the successful bidder would be required to immediately designate the particular combination which he proposes to use, upon which the proportions are officially designated by the department, and these proportions will govern just so long as materials from the same sources and of the same gradings as those used in establishing the mix are supplied.

This specification it will be observed places the responsibility of securing concrete of the required quality upon the department, where it belongs. The contractor is relieved of any responsibility as to the *strength* of the concrete obtained, just so long as he complies with all the details of the specification as regards materials, mixing, placing, finishing, and curing of the concrete. To hold the contractor responsible for the strength of the concrete and at the same time specify the proportions and other details of manufacture is not an equable contract. If it is found necessary during construction to modify the proportions to obtain the design strength, provisions should be made to compensate the contractor for any additional cost. It is believed, however, that if the original tests upon which the design is based have been carefully conducted in the laboratory the necessity for such changes will only occasionally occur.

It must be remembered, of course, that the proportions which have been designated have been determined on the basis of laboratory tests made under standard temperature and humidity conditions. Let it be assumed for instance that the concrete has been designed to give a modulus of rupture of 600 pounds per square inch at 28 days under laboratory conditions. It is well known that the temperature and humidity conditions which obtain on the job will influence the rate at which the concrete develops strength under job conditions. In other words, the design strength, say 600 pounds per square inch, may be attained under certain favorable weather conditions in much less than 28 days, whereas in other cases it may take more than 28 days. In order to determine the rate at which the pavement gains in strength, which in turn fixes the date on which it may be safely opened to traffic, it is necessary to make beam tests on the job, using specimens cured under as nearly identical conditions to the pavement as possible. Field tests of this nature should not, however, be used to verify the correctness of the original design because the specimens have not been cured under standard conditions. It is a mistake to attempt to verify the design by means of field tests. If for any reason it is suspected that the original design is at fault additional *laboratory* tests under *standard* conditions should be made, using materials obtained from the job. If under these conditions the proportions are found to be incorrect they should be changed, the additional cost, if any, being borne by the state and not by the contractor.

The aggregate specifications contained in the accompanying specification-draft follow the latest American Society for Testing Materials and American Concrete Institute form. The most interesting feature is the provision for inserting intermediate size requirements, after the source of material has been designated, so as to control the uniformity of the grading. The intermediate size requirements should, of course, be set so as to insure material of essentially the same grading as the samples used in establishing the design. It will be observed that two sizes of coarse aggregate are required where the maximum size is greater than 1½ inches. It is felt that this is necessary in the case of the coarser aggregates in order to prevent segregation and consequent danger of variations from the gradation used in establishing the proportions. The material over 1½ inches is designated as a separate size and the proportions given the bidders for all such materials will show the total quantities of materials of *each size* per cubic yard of concrete.

Comments and suggestions regarding this specification are requested and should be addressed to E. F. Kelley, Chief, Division of Tests, Bureau of Public Roads, Washington, D. C.

Suggested Specification for Concrete Pavement

1. *Description*: This item shall consist of a wearing course composed of Portland-cement concrete, with or without reinforcing steel as required, and shall be constructed on the prepared subgrade or completed and accepted base course in accordance with these specifications and in conformity with the lines, grades, thickness, and typical cross section shown on plans.

2. *Composition of Concrete*: (a) The proportion of cement, aggregates, and water will be fixed by the department on the basis of laboratory tests of concrete, using aggregates from the same sources and of the same gradings as will be employed on the work.

(b) The mixture will be designed to produce concrete of the required workability having a modulus of rupture of at least .... pounds per square inch at 28 days when tested by means of standard laboratory methods.

Note to Bidders: The department will furnish prospective bidders, upon request, the proportions by weight which will be required for all aggregates from such regular established commercial sources as are available for use on the project. This information will also include the grading requirements which apply in each case.

In the event that any prospective bidder desires to use local materials, the department will furnish the above information in cases where preliminary tests to establish the proportions have been made. In cases where no preliminary tests have been made and there is not sufficient time to conduct the necessary tests before bids are received, the department will furnish a preliminary estimate as to the proportions required, subject to modification without additional compensation to the contractor should tests later indicate that the preliminary proportions were incorrect.

(c) Immediately upon notice of award, the contractor shall furnish the department with the exact location of the source or sources of aggregates which he proposes to use. The proportions will then be officially designated by the department in accordance with the provisions of Section 2 (a) above. Such proportions will govern so long as materials are furnished from the sources originally designated and so long as they continue to meet the requirements hereinafter specified, subject only to slight variations in the relative quantities of fine and coarse aggregate for the purpose of securing maximum workability.

(d) In the event the contractor wishes to use aggregates from sources other than those originally designated by him, the department reserves the right to change the proportions to meet the strength requirements given under Section 2 (b) with the aggregates actually furnished.

3. *Materials*: (a) *Cement*: Portland cement shall conform in all respects to the requirements of the American Society for Testing Materials Standard Specifications C9-26, with amendments to date of contract.

(b) *Mixing Water*: Water shall be clean, clear, free from oil, acid, alkali or vegetable matter and shall not be used until the source of supply has been approved. If at any time the water from this source shall become of unsatisfactory quality, the contractor shall be required to provide satisfactory water from some other source. Water of doubtful quality shall be tested in accordance with the method prescribed in U. S. Department of Agriculture Bulletin No. 1216.

(c) *Fine Aggregate*: (1) *General Characteristics*: Fine aggregate shall consist of natural sand or other approved inert materials with similar characteristics, or a combination thereof, having hard, strong, durable particles, and shall conform to the requirements of these specifications.

(2) *Deleterious Substances*: The maximum percentages of deleterious substances shall not exceed the following values:

	Per cent by weight
Removed by decantation	3
Shale	1
Coal	1
Clay lumps	1
Other local deleterious substances (such as alkali, mica, coated grains, soft and flaky particles)	—

The sum of the percentages of shale, coal, clay lumps, soft fragments, and other deleterious substances shall not exceed 5 per cent by weight.

All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colormetric test for organic impurities and producing a color darker than the standard shall be rejected unless tests of the material in concrete indicate that the organic impurities are not of a deleterious nature.

(3) *Grading*: Fine aggregate shall be well graded from coarse to fine and shall meet the following requirements:

	Per cent
Passing ⅜-inch sieve	100
Passing No. — sieve —— to	—
Passing No. 50 sieve, not more than	35
Passing No. 100 sieve, not more than	5

The intermediate grading requirements above indicated are for the purpose of controlling the uniformity of deliveries of materials. They should be inserted after the contractor has notified the department as to the source of material he intends to furnish and will be so selected that material will be furnished which has the same gradation as the samples used in establishing the proportions.

(d) *Coarse Aggregates*: (1) *General Characteristics*: Coarse aggregate shall consist of crushed stone, gravel, blast-furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces, free from adherent coatings and conforming to the requirements of these specifications.

(*Continued on page* 16)

A Message to Foremen[1]

By H. W. Heinrich,

Assistant Superintendent, Engineering and Inspection Division, The Travelers Insurance Company

SEVENTY-FIVE years ago, a young man less than twenty was engaged as a divisional railroad-telegraph operator at a salary of thirty-five dollars a month. His authority and apparent responsibilities were limited. He was ambitious, however, and with a view to the future not only mastered every detail of the work assigned to him, but also gradually acquired a comprehensive knowledge of the operation of the entire railway system. One morning, the general superintendent of the division was late in arriving at his office, and in his absence an accident had occurred. Immediate and decisive action was required. By virtue of his thorough knowledge, the young telegraph operator grasped the situation at once, and realizing the necessity for someone to assume responsibility, he took immediate action. There was only one track on this particular division and freight trains were waiting for the express, which had the right of way. He telegraphed orders to the conductor of the express, to give the freight trains three hours and forty minutes of express time, and asked for an acknowledgment. He then wired to the conductor of each freight train to proceed—thus clearing up a situation that might have resulted in confusion, delay, and loss of revenue.

The subsequent progress and development of this young man, in the business world, were truly phenomenal. Advancement to increasingly important positions convinced him that the acceptance of responsibility is a vital factor in industrial leadership. He became an employer (giving profitable work to thousands of men and women), a financial power, a steel magnate, and a multi-millionaire. He endowed charitable and educational institutions, and his death, at a ripe age in 1919, was mourned by the whole world.

The biographies of eminent and successful men of past generations are replete with illustrations of the same kind. Prominent men of today—Hoover, Schwab, Crowley, Ford, Davis, Edison, Pelley, and a host of others—believe in responsibility and accept and practise it. Dodging responsibility or "passing the buck" is practically an unknown quality in the make-up of successful men. Gantt said: "The authority to issue an order involves the responsibility to see that it is properly executed."

One of the many successful men who have worked in supervisory capacities as foremen or leaders while making their way to top, said: "Good management is of more avail than perfect equipment." Napoleon stated that "Every man carries the baton of a marshal in his haversack." He was speaking of soldiers, but the same principle applies to industrial workers. The baton of a successful executive, namely, the recognition of his responsibilities and the will to accept them, lies in the hand of every foreman.

One of the most important industrial problems is that of training men in the habits of industry—safe and efficient habits. We need not lay so much stress on results of a temporary nature, if our methods are correct. The new worker follows the habits of the older men, and of his foreman; therefore this training must be done largely by foremen.

Genius is but the capacity for taking infinite pains. Success depends upon intelligence and hard work, and above all, with regard to industrial leaders and executives, it depends upon the ability and willingness of the individual to accept responsibility.

A supervisor or a foreman stands upon the first rung of the executive ladder. Because of certain valuable personal qualities, he has been selected to direct the work of other employees. Unfortunately, in the average case, he enters upon this phase of work uninstructed in the art of executive leadership—and so gradually that he may not realize that his functions as an executive are markedly different from those of an employee without authority. Sometimes an employee is selected for a position of authority merely because he is a more skilful workman than his neighbors, and the choice proves to be an unwise one.

And yet, the intelligence of the foreman, and his vision, leadership, executive qualities, and ability to interpret the principles of the concern that he represents, may be important factors in the profit or loss of a business, and in the prestige, smooth functioning, efficiency, economy and ultimate success or failure of the organization.

We read, of the "man behind the plow," of the lowliest laborer, of the capitalist, the professional man, the artist, and the scientist. All are eulogized. But Oh, for the skill of the Hoosier Poet, to picture in

[1] Delivered at the Seventh Industrial coarse of The Syracuse Safety Council, November 14, 1929.

homely verse the real key man of industry, the hub of the masses—the foreman.

Human intelligence is only valuable as it is used. It is said that only one one-thousandth part of the average brain capacity is actively employed. If this is true, then a man may become an outstanding success by putting just a bit more of that "grey matter" to work than does his neighbor. In no place or position in the world is there a better opportunity to show results and win success than in foremanship. Commonsense, logic, initiative, and acceptance of responsibility are all that are required. We take loyalty, knowledge of the job, and work-capacity for granted, for without them we have no business to accept wages or salary from an employer.

Thousands of employers have thought and said, at times: "Show me a man who does what he is told, and does it intelligently, and I'll show you a man that will be successful." Likewise, I say, "Give me a foreman who can accept responsibility and I'll show you a man that gets results." What is there about responsibility that makes it so hard to accept? Nothing but unwarranted fear—fear of failure, fear of consequence. It is true that every man who tries may fail; every man who leads must accept the consequences. Bear in mind, however, that straddling the fence gets us nowhere, and that in accepting responsibility we at least expose ourselves to the probability of winning sometimes; and when we *do* win, the consequences that we were so afraid of turn out to be happy ones. Fear to accept responsibility is rank pessimism. If we are afraid, it is because we think we can't win.

Fear to accept responsibility keeps more good men in subordinate positions that any other one factor.

A live-wire superintendent once said to a trusted foreman: "Go ahead and set up the job and turn out the work." What an opportunity for a good foreman! In this case, however, as in many others throughout industry, a series of questions followed, instead of action. The foreman wanted to know when to start, what men to use, where to get the tools, and how soon the job was wanted. He complained also that he would have to neglect other work if he did this job, and, in fact placed the entire burden of responsibility right back upon the superintendent, who was obliged to supervise the job himself. Now, bear this in mind: The job was done. Work was redistributed so that the new job could get under way without disrupting the regular production schedule. All the trivial questions and objections raised by the foreman were ironed out, but not by him—by the superintendent.

If the foreman had understood responsibility and been willing to accept it, he would have realized that here was an opportunity to advance his own interests. Instead, his negative attitude clearly showed that he was not yet ready for a position of authority.

The reaction of the superintendent to the foreman's failure to assume responsibility, was one of disapointment, irritation, and dissatisfaction. Said the Scotch poet: "Oh would some power the giftie give us to see ourselves as others see us." Foremen of America, think over this idea of accepting responsibility. There's meat in it—yes, money and success.

Of all the time-wasting, irritating, and costly situations that bedevil the life of the busy executive, there's none so trying as that which is brought about by the foreman who isn't a foreman, and who places on the executive's shoulders the burden of responsibility that he, himself, is paid to assume. Foremen are paid to run their departments and to supervise their men.

There's another and more cheerful side to the picture. A foreman was called into conference on a most difficult production problem. The management was extremely anxious to accept a large order for a certain product for the manufacturer of which the machinery in the plant was not designed. The executives were frankly skeptical of their ability to do the work, and called in the foreman of the automatic-screw-machine department—chiefly to have him confirm their doubts. With an air of kindly tolerance, the general manager said: "Jones, can we turn out 10,000 of these pieces in one month?" To the intense surprise of the men in conference, Jones said, after carefully studying the sample: "Yes, we can fill that order. Shall I start at once?" "Now wait a minute, Mr. Jones," came the answer. "Frankly we thought it was impossible. How do you propose to go about it?"

"Well," said the foreman, "it's an unusual job and won't go on our standard machines; but we still have those special turret lathes that were taken out of the department when we reorganized, and they will handle the job nicely. I'll have them set up again, if you so say. The cost will be nominal. We'll have to have some special cutters made by the tool department. The wooden handles can be bought in town, and the assembly can be done here. We'll need a precision gage of special make, and an extra operator whom I can borrow from Building B where work is a bit slack at present."

Summing it all up, the foreman displayed a knowledge of the business and an intelligence that was grati-

fying and surprising. Further, he seemed to know so much about how the job should be done that he was allowed to do it. Not only did he fulfill his promise with regard to his own part of the work in the automatic-screw-machine department, but in addition, he gave such evidence of executive ability that he was authorized to deal with the novelty wood-working plant for the purchase of handles, and also to supervise the assembly, finishing, and testing operations.

Jones is now assistant general works manager of this plant. He was a good foreman; he knew how to accept responsibility. Suppose he had failed. But why suppose? Know your job, and then go ahead and accept responsibility and you cannot fail. That is what Jones did, and you, also, can do it equally well.

Industry must have capital. It needs the services of inventors, scientists, mathematicians, and engineers. It must have executives, salesmen, and production managers. Employers there must be, if employees are to receive remuneration, but the hub of the wheel, the heart of the industrial situation, is the man who personally directs the work of the employees. By whatever name he is called—foreman, supervisor, gang-boss, head man, or straw-boss—there is after all only one man who tells the worker what to do and how to do it, and sees to it that the work is done; and that man, whom I refer to herein as a foreman, controls his own fortunes and plays an important role in the success of the organization of which he is a part.

Responsibility—the hallmark of success—accept it and succeed. Do not waste time on matters of finance or personnel when they are outside of your job, but remember that practically all operations and methods of procedure are related to your work, in one way or another. Learn about them and become familiar with them; be ready, always, to take the job of the man next higher up; take advantage of the opportunities that so often come to persons with a sense of responsibility; and in accepting responsibility do not fear that you will be alone. The higher pay that accompanies the better positions may not require more manual labor, but it must be earned; and one way to earn it is by accepting responsibility whenever the opportunity offers. The superintendent and works manager the production and sales heads, yes, the president of your company himself, must accept responsibility. Your mistakes are their mistakes. Your success is their success. The board of directors of the stockholders must have an accounting with someone for everything that goes on.

Do you suppose that any high executive officer would dream of saying to a board of directors: "I'm sorry, gentlemen, but I am not to blame. That big order was lost because one of my foremen turned out a batch of goods of inferior quality." This executive directs the employment of the men—their training and instruction—he provides the tools and enforces supervisory methods, and is responsible for events that occur even while he is away from the plant. How about you? You, as a foreman, know your men; you personally instruct and train them, you are on the job, and have the best opportunity in the world to correct improper practices before they cause trouble. Don't make the mistake of dodging responsibility—and, bear in mind, that "goes" for everything that happens in the conduct of the work under your supervision. Accidents, for example, are your responsibility, just as much as are errors—for, in fact, accidents really are errors. Production and quality of work are your responsibility; so are discipline, order, morale, and good housekeeping.

Injuries resulting from accidents occur far too often. Thousands of lives are lost and immeasurable suffering exists because of accidents. Billions of dollars are lost annually. You and all other purchasers, and the consuming public in general, pay these losses in the prices charged for food, clothes, shelter, and the other necessities and luxuries of life. Research proves that 98 per cent of accidents are preventable and that 88 per cent are due, not to unguarded machinery but to supervisory conditions within the control of the foreman. Accidents represent man-failure, and the foreman is the one person in industry who knows how to control men.

Do you realize that the real causes of accidents are likewise the causes of inefficiency, poor economy, poor production, and poor business generally? They are! Here are some of them: Failure to issue and enforce instructions, inattention, poor discipline, improper and unsafe practices, inexperience, and undue haste. Are not these conditions the very ones that you, as a foreman, are fitted by experience to control? Moreover, you actually do control them when they affect volume and quality of work. Suppose you are requested to fill an order for a certain number of units of production, and in giving instructions to your men one of them says that he can't follow them because he is too busy; or suppose that he follows the instructions half-heartedly and makes mistakes or spoils much valuable material. Quite properly, discharge or other severe penalty is the very last remedy you would resort to,

yet you as a foreman—a leader of men—do not admit failure. You "get results" by one means or another. The work goes along, difficulties are ironed out. By applying true foremanship the job is done, and done properly. In carrying on your work successfully you are controlling the conditions that affect profitable production.

Bearing in mind that these conditions are likewise the ones that produce injuries, it is obvious that you can control accident occurrence just as readily as you can govern defects and volume of production. This fact becomes more obvious when it is recognized that a serious injury is not an isolated happening by itself, but is the logical consummation of 329 other precisely similar accidents, all of which have the same cause, but 300 of which do not result in actual injury. The employee who is injured as the result of an accident has, in the average case, made the very same mistake, the same error of judgment, violated the same instruction or taken the same chance, that finally caused the injury, many times before without, however, having been hurt. There lies the opportunity of the foreman to control accident-frequency. There, in the foundation of injury—the accidents that have not yet caused injury—is the place to direct an attack. Injuries are like water over the dam. Learn from them but go to work upon the "injury in the making"—one of the 329 accidents that, in the average case, precede every serious injury. They are all visible occurrences and may readily be observed and corrected before trouble occurs.

Keep this ratio of accidents to injuries in mind when next you hear the assertion "This is the first time an accident of this kind ever happened." It may be the first time a serious injury occurred, but hundreds of similar accidents undoubtedly occurred which, fortunately, produce no injury, and these may be observed and checked by the very man who should hold himself responsible for them—the foreman.

We need to differentiate between blame (or guilt) and responsibility. A foreman need not hold himself morally guilty when an employee in his charge is injured, but he cannot and should not evade responsibility under any circumstances whatsoever.

Remember that the authority to issue an order involves the responsibility to see that it is properly executed. The country depends upon you—the key man of industry, the foreman—to maintain that leadership among nations, of which we are so justly proud, in the safe, peace-time development of industry.

385 Grade Crossings Eliminated From Federal Aid Roads in 1929

IN 1929, a total of 385 railroad grade crossings were eliminated on the Federal-aid highway system, according to a report just issued by the Bureau of Public Roads of the U. S. Department of Agriculture.

Forty-eight crossings were eliminated by the construction of grade-separating bridges carrying the highway over or under the railroad; and 337 by relocation of the highway to avoid the railroad. Since 1917, the records of the bureau show, a total of 4,676 grade crossings have been weeded out of the system—995 by grade separations and 3,681 by relocations.

Georgia heads the list with 82 eliminations in 1929. Alabama is second with 40; Texas reported 34 eliminations; Montana, 27; and Mississippi, 18. Kansas and Washington each reported 15; Arkansas, South Carolina and Wisconsin, each 12; Florida, Nebraska, Oklahoma and Wyoming, each 10; and Minnesota and Virginia, each weeded out 9.

Texas heads the list of elimination by grade separations with 9; Kentucky is second with 6; Wisconsin reported 5; Montana, New York, Oklahoma and Oregon, each reported 4; Connecticut, Missouri, South Carolina, Utah, Virginia, West Virginia and Wyoming, each reported 5.

In the list of eliminations by relocation, Georgia leads with 94; Alabama is second with 43; Texas reported 25; Montana, 23; Mississippi, 17; Washington, 14; Kansas, 13; Arkansas, 11; Florida, 10; and Newbraska and South Carolina, each 9.

Elimination of the grade crossings is regarded by the Bureau of Public Roads as the only positive means of reducing the heavy toll of human life taken annually at points where highway and railways cross. The various protective devices, including gates and watchmen, though necessary until eliminations can be effected, do not afford adequate protection on heavily traveled roads, and are objectionable also because of their obstruction of the free movement of traffic on the highways.

Not only can the foreman be of great aid in the prevention of accidents, but he is the one to whom the workmen look for assistance if an accident does occur and in this capacity the prompt and effective application of first aid measures are of greatest importance to the welfare and recovery of the injured man.

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Profitless Orders

IN a certain manufacturing company the mills have an employees representation plan, whereby a vote must be taken before any change in the wage scale can be made. Recently, the employees of this company were asked to answer a difficult question. A large order for the commodity of this company was in sight, but at the price set officials realized that no profit could be made unless wages were reduced.

According to the report of the incident by the *Journal of Commerce*, "The ballot called for a 'yes' or 'no' vote on the proposal for readjustment of wages, applicable only to work on the order under consideration. The decision against the proposal was carried on a four-to-one ratio. Officials told the employees that a reduction in wages would be necessary to guarantee a small profit, so close is the margin necessary to obtain the order. No intimation was given as to the source of the order."

By a decidedly prominent majority the mill employees determined that a big order was not worth a wage reduction and thus in the opinion of many, performed a real service to the company.

This story, however, has a significance far greater than that. It clearly shows the existence of two schools of management which are diametrically opposed.

In the one, the view is held that regardless of cost the plant must be kept running and that it is economical to operate without profit temporarily, rather than lay off men. Under such conditions labor must share with management and capital the temporary sacrifice of profits.

No order should be taken at a price which does not allow for a fair profit, when costs are accurately figured, is the equally vehement contention of the other school. It feels that a concern which sells its commodity below the cost of production can seriously injure an entire industry and that the man who sells below cost whether unintentionally or through ignorance, is an economic criminal who in the interests of the industry at large should be restrained by law.

The most obvious and practical solution of the entire problem would seem to be through the establishment of the long suggested uniform system of cost accounting, resulting in the accurate determination of costs on a known and generally comparable basis.

Until such a day arrives there will always be some manufacturers who do not figure their costs as accurately as their competitors and consequently will step in and take the close order even though to do so may be selling below cost.

The crushed stone industry like many others is unfortunate in still having within its ranks some who feel that it is sound business to keep the plant running at any price even to the extent of selling below cost. There is no surer way of demonstrating the fallacy of such an argument than by establishing a system whereby each and every crushed stone producer will be accurately and definitely informed as to his costs of production.

A committee on uniform cost accounting has recently been appointed by President Wise to study this question and the sympathetic cooperation of the entire membership should be accorded this committee in its efforts to bring about an adequate solution to the problem of uniform cost accounting.

President Signs $300,000,000 Road Bill

PRESIDENT Hoover on April 4 signed the Dowell-Phipps highway bill (H. R. 5616) carrying authorization of $300,000,000 for road construction under the Federal aid plan, throughout the United States.

Of the total, $125,000,000 is authorized to be expended as the Federal government's contribution to road construction during the fiscal years 1932 and 1933, and $50,000,000 is added to the $75,000,000 already authorized for 1931.

When he approved the measure, President Hoover made available what was described by representatives of the American Association of State Highway officials, who were present at the signing of the bill, as the largest authorization for a road building program ever passed by Congress. It exceeds all previous amounts for such purposes by $50,000,000 per annum. The authorization for road building is increased from a total of $75,000,000 to $125,000,000.

President Hoover in approving the bill declared, it was stated orally at the White House in his behalf, that while the appropriation authorized carried a large increase in funds over previous years and the Department of the Treasury has many other expenditures to take care of, he felt that this money was to be put to a highly useful purpose and added that he was therefore glad to sign it.

The bill was signed by the President in the presence of the entire membership of the House Committee on Roads, headed by Representative Dowell (Rep.), of Des Moines, Iowa, and the Senate Committee on Post Offices and Post Roads, headed by Senator Phipps (Rep.), of Colorado, and by representatives of the American Association of State Highway Officials.

Two pens were used by President Hoover in signing the measure—one was given to Senator Phipps and the other to Representative Dowell, authors of the bill.

After the signing of the bill, W. C. Markham, executive secretary of the State highway officials, with headquarters in Washington, D. C., stated orally that each year the States have provided funds far in excess of the Federal authorizations, at such a ratio that the increase of Federal funds of $50,000,000 for 1931 really means an increase in the road building program of not less than $120,000,000.

"Coming at this time when there is great need of relief for unemployment," Mr. Markham said, "it will mean an immediate quickening of the industries connected with all phases of the road-building industry and not less than 125,000 additional men will be put on a steady pay roll for this season.

"Many of the State highway departments have surveys and plans completed for additional mileages and with the passage and approval of this bill, there will be immediate calling for bids on these projects."

Similar Accidents Could Occur In Your Quarry

IT is often said, "Forewarned is forearmed," and particularly is this true in guarding against quarry accidents.

We learn from the April issue of *The Quarry and Surveyor's and Contractors Journal* of three fatal accidents occurring in British quarries during the last four weeks, each of which was primarily the result of plain carelessness. Similar accidents can and do occur in our quarries unless we are ever alert to convince the workmen of the necessity of accident prevention. Following is a brief description of the accidents referred to as given in *The Quarry and Surveyors and Contractors Journal*:

(1) A quarryman, having levelled the stone in a railway wagon, which was standing in a siding, unfastened the brake and lowered the wagon down a slight gradient. He was riding on the front footplate and attempted to apply the brake, after travelling about 50 yards, when he fell off in front of the wagon and sustained fatal injuries. It was not part of his duty to lower the wagon; moreover, riding on the wagons is prohibited and notices were posted to that effect.

(2) Three workmen were engaged in removing overburden 7 feet deep, consisting of layers of soil, clay and boulders. They had undermined to a depth of 1 foot for a width of 12 feet, and in order to cause a fall one of the men went on top and drove a bar into the ground. As the fall occurred, another man who was standing clear 6 feet back from the face, foolishly bent forward with his shovel, apparently to remove a boulder to facilitate felling, and was caught by the fall and sustained a broken neck.

(3) A quarryman was standing on a ledge about 5 feet wide levering a large stone with a crowbar, when he evidently overbalanced and fell 35 feet to the bottom of the quarry. The accident would not have occurred had lashing ropes been provided.

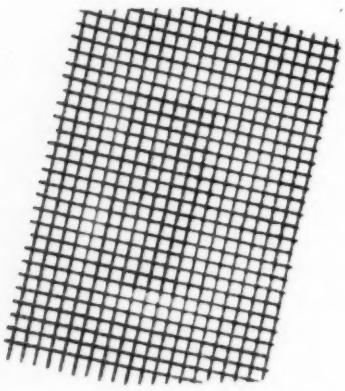
Bulletin No. 1 to Be Reprinted

Since exhausting the last issue of Engineering Bulletin No. 1, "The Bulking of Sand and Its Effect on Concrete", so many requests have been received for copies that it seems advisable to reprint it and this will be done in the immediate future. It would be helpful in estimating the number to be printed if those desiring copies of this Bulletin would immediately advise the Washington Office.

TISCO

TIMANG

far outlasts other screen cloths



— on the toughest material screened

TIMANG—the improved manganese steel screen cloth, again proves its ability to outlast other screens in severe service.

The section of TIMANG screen pictured above was in service for 64 days handling by-product oven coke on a popular type of vibrating screen. Whereas, the best service obtained from other screens on this operation was only 10 days.

TIMANG is the new patented manganese steel — which combines the toughness and wear resistance of manganese steel with unusual ability to withstand vibration stresses.

Unequalled for screening crushed stone, sand and gravel, trap rock, cinders and other abrasive material. Send for bulletin.

TW

TAYLOR - WHARTON IRON & STEEL CO.
High Bridge, New Jersey

Tests of Pavement Concrete Being Conducted by the U. S. Bureau of Public Roads

(*Continued from page* 9)

(2) *Deleterious Substances*: The maximum percentages of deleterious substances shall not exceed the following values:

	Per cent by weight
Removed by decantation	1
Shales	1
Coal	1
Clay lumps	¼
Soft fragments	5
Other local deleterious substances (such as alkali, friable, thin, elongated, or laminated pieces)	—

The sum of the percentages of shale, coal, clay lumps, and soft fragments shall not exceed 5 per cent by weight.

(3) *Quality*: Coarse aggregates shall meet the following requirements:

Crushed stone	
Per cent of wear, not more than	7
Gravel	
Per cent of wear, not more than	15
Blast-furnace slag	
Weight per cubic foot, not less than	70 lbs.

All coarse aggregates shall be subjected to five alternations in the sodium sulphate test for soundness and those showing evidence of marked checking, cracking or disintegration in this test shall be rejected unless it can be shown to the satisfaction of the department that such aggregates have proven entirely sound in service.

4. *Grading*: Coarse aggregate shall be well graded from coarse to fine, and shall meet the following requirements:

(a) When the coarse aggregate has a maximum size of 1½ inches or less:

	Per cent
Passing a 1½-inch sieve	100
Passing a —— sieve — to	—
Passing a ⅜-inch sieve, not more than	—

(b) When the coarse aggregate has a maximum size greater than 1½ inches the material less than 1½ inches in size shall be furnished in the grading given under (a) above and the material larger than 1½ inches shall be furnished as a separate size conforming to the following requirements:

	Per cent
Passing a 3-inch sieve	100
Passing a 2½-inch sieve, 95 to	100
Passing a 1½-inch sieve, not more than	15

The intermediate grading requirements indicated under (a) above are for the purpose of controlling the uniformity of deliveries. They shall be inserted after the contractor has notified the department as to the source of material he intends to use and will be so selected that material will be furnished which will have the same gradation as the sample used in establishing the proportion.

Motor Fuel Taxes $431,636,454 in 1929

The 48 States and the District of Columbia collected $431,636,454 in taxes on the sale of 13,400,180,062 gallons of motor fuel in 1929, reports received by the Bureau of Public Roads of the U. S. Department of Agriculture show. This includes a 12-month collection in 46 States and the District of Columbia, a five-month collection in Illinois, and the collections of eight months in New York. Illinois and New York were the last States to adopt this method for part payment of the highway bill. The pioneer States—Oregon, Colorado, North Dakota and New Mexico—led the way in 1919. Now all the others have followed, but the tax did not become effective in New York until May 1 and in Illinois until August 1.

The average fee per gallon was 3.22 cents as against 3 cents in 1928. In the course of the year 20 States increased the rate of taxation either one or two cents. The highest tax per gallon was six cents; the lowest two cents. At the close of the year, three States had a six-cent tax; eight a five-cent tax; 19 a four-cent tax; one, Utah, a 3½-cent tax; 10 a three-cent tax; and seven States and the District of Columbia a two-cent tax.

In 1929 the rate per gallon was increased one cent in Colorado, Florida, Indiana, Kansas, Minnesota, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Vermont, Washington, and Wyoming; two-cent increases became effective in Georgia, Louisiana, Montana, Nebraska, Tennessee and Texas.

Comparison of the total number of vehicles registered in 1929, with the total tax collected and with the taxable gallonage in all States (except New York and Illinois) and in the District of Columbia shows an average tax revenue of $17.72 per vehicle and an average purchase of 532 gallons of gasoline.

After deducting collection costs, the entire net revenue in 34 States was used for construction and maintenance of rural roads. In the other fourteen States and the District of Columbia, a total of $24,405,207 was used for other purposes.

Of the revenue applied to rural roads, $297,967,756 was used for construction and maintenance of State highways; $85,113,708 for construction and maintenance of local roads; and the remainder, $23,371,785, applied as payments on State and county road bonds.

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800 (2½ CU.YDS.) and 900 (3½ CU.YDS.)

with DIRECT DIESEL DRIVE

Direct Diesel drive has made a distinct impression upon engineers and others responsible for loading costs.

Power is applied *directly* to the hoisting, traveling, crowding, and swinging mechanisms. No complicated electrical generators and motors are interposed between the engine and the parts that do the work. This direct, simplified drive insures maximum delivery of power to the digging end.

There are many other advantages of Diesel drives. Only a small volume of low-cost fuel is required. The engine torque actually increases when the machine is slowed down below 50% of normal speed in heavy digging. Combined, these things insure low-cost yardage.

A new conception of shovel economy awaits you. Ask for Bulletin describing P & H Types 800 and 900 Diesel Shovels fully.

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FLEXCO
HD Belt Fasteners
These well known fasteners stop trouble with elevator and tight butt conveyor joints. They have far more strength than needed and the pull is equalized on both sides of the belt insuring long service. Note recessed plates which embed in and compress the belt instead of pulling against the bolt holes. Stocked by leading jobbers in 5 sizes. Consultation invited.
Flexible Steel Lacing Company
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Recommended by leading belting manufacturers
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States to Spend More for Highways

REPORTS received from state highway departments and compiled by the Bureau of Public Roads, U. S. Department of Agriculture, show that state and local authorities plan to spend $1,601,167,455 for highway improvement in 1930.

The planned expenditure by state highway departments for construction and maintenance of state highways is $937,500,455; the balance, $663,667,000, will be spent, according to the estimates, on local roads and bridges. The state highway officials of 45 states estimate the total length of roads to be improved by them in 1930 as 32,532 miles, an increase of 3,126 miles over the estimate in the 1929 programs. Three states failed to report contemplated mileages for 1930.

The highway departments of all states will control the maintenance of 281,393 miles of highways this year, an increase of 32,381 over the mileage under state maintenance in 1929. Gradually, the states are taking over into their systems for maintenance the more important county and local roads of the country.

The states of greatest population and industrialization in which unemployment, naturally, is greatest, show the highest contemplated expenditures. The Middle Atlantic States, comprising New York, New Jersey, and Pennsylvania, plan to spend $374,835,310 on improvement of state and local roads; the East North Central States of Ohio, Indiana, Illinois, Michigan, and Wisconsin plan to spend $303,696,000.

The West North Central States, including Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas rank third in their contemplated expenditure of $236,461,727, and the South Atlantic States of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida, with an expenditure of $182,872,418 rank fourth; the West South Central States of Arkansas, Louisiana, Oklahoma and Texas rank fifth with an expenditure of $154,100,000; and the Pacific States comprising Washington, Oregon, and California rank sixth with an expenditure of $121,590,000.

Kentucky, Tennessee, Alabama, and Mississippi, making up the East South Central group, plan to spend $101,992,000 on state and local road improvement; Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut in the New England group plan to spend $75,430,000; and the Mountain States of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada, $50,190,000.

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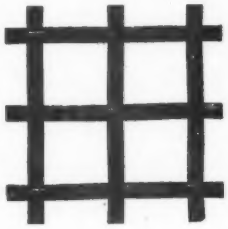

We could tell you all about Kok-tex. That it's woven on improved power looms. Made from special analysis wire for strength. Galvanized after weaving for extra durability.

We could quote the comments and praises of users. Cite practical tests which prove its superiority and lasting power.

We could do all this, yet we might not absolutely convince you. Using Kok-tex is your best proof of its real superiority, its value to you. It will be to your advantage to remember this when you place your next order. Send for samples and prices.

Made in all standard sizes—used in the Stone industry.

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The quality of CROSS Screens gives longer service, increased production and lower cost.

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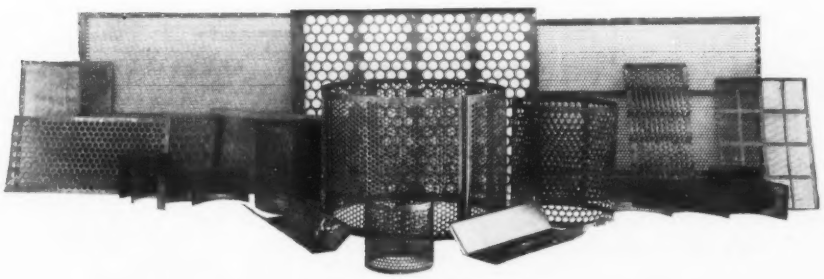

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THE record made by Hendrick buckets and screen plate is an excellent one. Low costs against the tonnage handled have been universal, the reason being that Hendrick products are well made.

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A New Book on Herringbone Speed Reducers

W. A. Jones Foundry and Machine Company, of 4401-4451 West Roosevelt Road, Chicago, has just published a complete and well-illustrated catalogue on Herringbone and Herringbone-Maag Speed Reducers that should be of interest to every mill superintendent and every designing engineer. In text and tables and illustrations they claim this new catalogue Number 45 is the latest, up-to-the-minute word on the herringbone type of reducer. The book, totalling some eighty pages is divided into three sections. The first goes into detail about the whys and wherefores of the herringbone and its manufacture; the second part is devoted to tables that are a guide to the rating and selection of this type of reducer, giving detailed technical information, measurements, and so forth; and the third part consists of a large number of photographs showing actual installations.

$50,000,000 Extra for Roads Allotted

Secretary of Agriculture Arthur M. Hyde, recently apportioned among the 48 States and Hawaii the sum of $48,750,000 of the additional $50,000,000 authorized by Congress as Federal aid for highway construction in the fiscal year beginning July 1, 1930. This supplementary appropriation for Federal-aid highways was authorized by the bill signed by President Hoover on April 4, which also authorized the appropriation of $125,000,000 for each of the fiscal years 1932 and 1933.

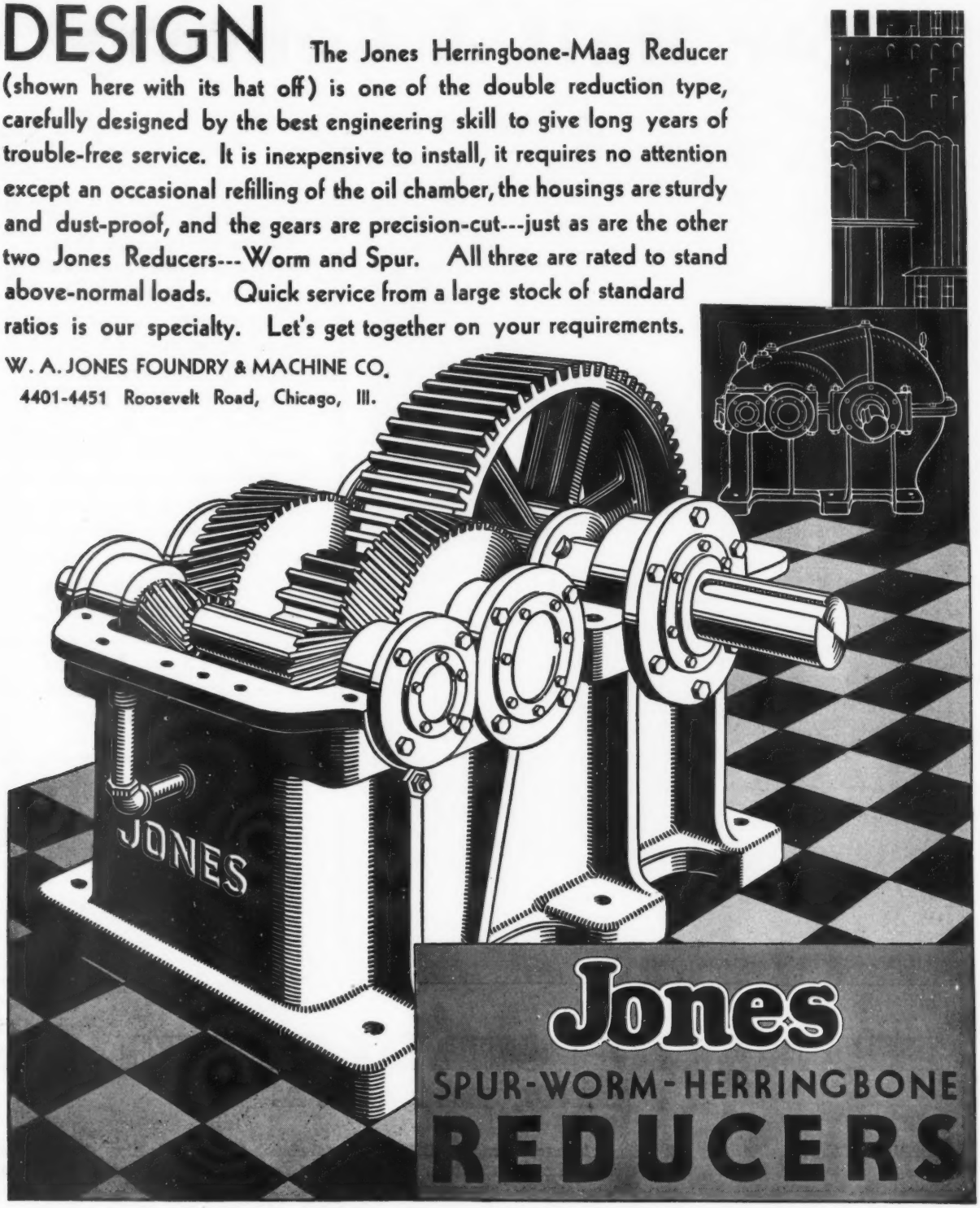
The additional $50,000,000 brings the authorized appropriation for 1931 to $125,000,000. Congress provided $75,000,000 by a previous act, and Secretary Hyde apportioned this among the States and Hawaii on December 2, 1929.

All apportionments of Federal funds for highways in the Federal-aid system are based on the area, population and post road mileage of the States, and the share of each State is available for expenditure on roads included in the Federal-aid system under the joint supervision of the State Highway Departments and the Bureau of Public Roads of the U. S. Department of Agriculture. Apportionment of the 1932 authorization will be made on or before January 1, 1931, and of the 1933 authorization on or before January 1, 1932.

DESIGN

The Jones Herringbone-Maag Reducer (shown here with its hat off) is one of the double reduction type, carefully designed by the best engineering skill to give long years of trouble-free service. It is inexpensive to install, it requires no attention except an occasional refilling of the oil chamber, the housings are sturdy and dust-proof, and the gears are precision-cut---just as are the other two Jones Reducers---Worm and Spur. All three are rated to stand above-normal loads. Quick service from a large stock of standard ratios is our specialty. Let's get together on your requirements.

W. A. JONES FOUNDRY & MACHINE CO.
4401-4451 Roosevelt Road, Chicago, Ill.



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For Half A Century

USERS expect more from Marions than from any other excavator built, regardless of price. They expect better design, more rugged construction and lower cost of operation. This is only natural because for practically a lifetime Marion has led the entire industry in these all-important characteristics. Because of this half century of leadership Marion is today more capable than ever to give users of excavators these features which frequently mean the success of the job.

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MARION

2

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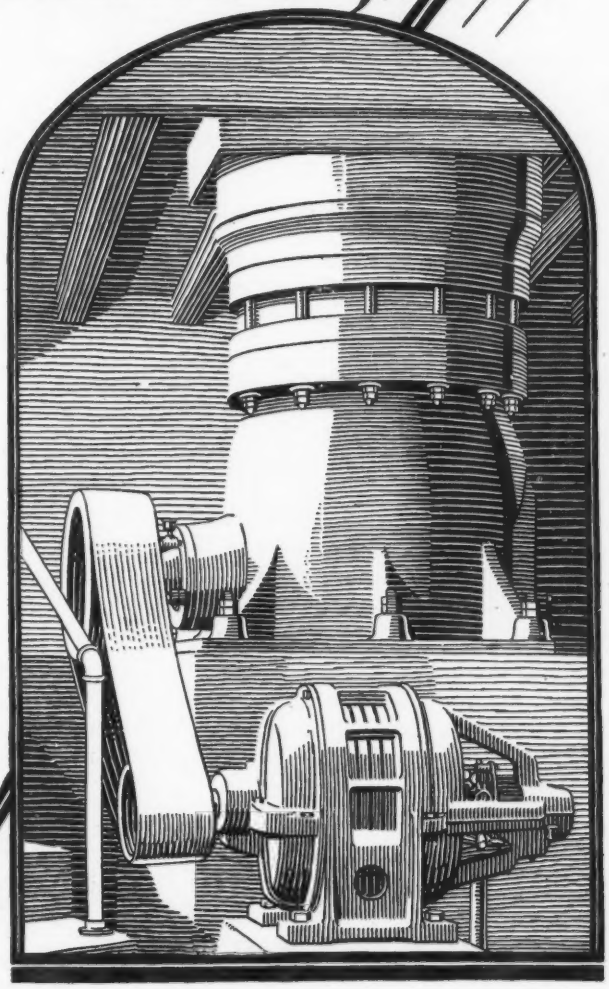
Meeting Every Power Need of the Crushed Stone Industry

For the new stone-crushing plants of 1930, and for the rebuilt old plants, too, specify G-E Motorized Power.

It is the power system that is designed to deliver the highest material output for the lowest kw-hr. input—the first requisite for low-cost production.

For plants of every size, G-E Motorized Power means the correct motor for each specific task; the control which will get the most out of the motor and machine with safety; and the correct application and co-ordination of motors and control for efficiency and economy.

The trend is toward G-E Motorized Power in the crushed-stone industry. In 1930, consult with G-E engineers on your needs. They are always ready to give you the benefit of their unexcelled facilities, wide experience, and advanced knowledge.



Apply the proper G-E motor and the correct G-E controller to a specific task, following the recommendations of G-E specialists in electric drive, and you have G-E Motorized Power. Built in or otherwise connected to all types of industrial machines, G-E Motorized Power provides lasting assurance of performance that builds confidence.

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» CHIPS «

Lucky it Wasn't the Hallelujah Chorus

John Philip Sousa loves to tell one about two members of his famous band, or rather, about their wives. One, a bride of a year, was pushing a perambulator in which were babies, triplets. The other had been only married for a few weeks.

"What beautiful babies!" exclaimed the newly married one.

"Yes," replied the proud mother, "and let me tell you the funniest coincidence. At our wedding, Mr. Sousa and some of the band serenaded us and they played 'Three Little Maids' from the 'Mikado.' Isn't that funny?"

At this the other bride turned pale. "Good heavens!" she gasped. "We were serenaded, too, and they played the Sextette from 'Lucia.' "—*Los Angeles Times.*

FIRST MOTORIST: "I had a drink of real moonshine the other day."

SECOND MOTORIST: "How was it?"

FIRST MOTORIST: "I find that I can get about the same result if I kiss a spark plug when my motor is running."—*The Texaco Mission.*

Justifiable Homicide

"Well," said the professor, "I believe that's all. And now are there any questions before the final?"

There came a voice from the back row: "What's the name of the textbook in this course?"

Well, of course, they acquitted the prof for shooting him.—*Ohio State Sun Dial.*

New Bidder: I've just landed a contract in good stiff competition and twenty thousand wouldn't buy it from me.

Experienced Bidder: I'm one of the twenty thousand.—*Exchange.*

Identity of the young lady is withheld, but the memory of her answer lingers on with the instructor conducting a science course at a local high school. One of the requirements in the written quiz was: "Define a bolt and nut and explain the difference, if any." The girl wrote:

"A bolt is a thing like a stick of hard metal, such as iron with a square bunch on one end and a lot of scratching wound around the other end. A nut is similar to the bolt only just the opposite, being a hole in a chunk of iron sawed off short, with wrinkles around the inside of the hole."

The startled professor marked that one with a large "A."—*De Laval Monthly.*

"Five gallons, please."

"Okay. How's your oil?"

"Just gas, please."

"How about a bottle of Shinyola—great for lacquer; your bus is all covered with traffic film?"

"Nope, just the gas."

"Your left rear tire's pretty well shot. Better let me put on a new one; we're selling Puncherproofs today for—"

"No, the gas will be all."

"How long since you had a grease job? Everything looks kinda dry—hear that body squeak?"

"Haven't time today—just the gas this time."

"How about one of our electric cigar lighters—clamp right on your dash and when you want a—"

"Hell, NO! JUST THE GAS!"

And as the indignant motorist drove away with his five gallons of gas, the filling station proprietor remarked to a by-stander:

"That there was my barber."

—*The Studebaker Wheel*

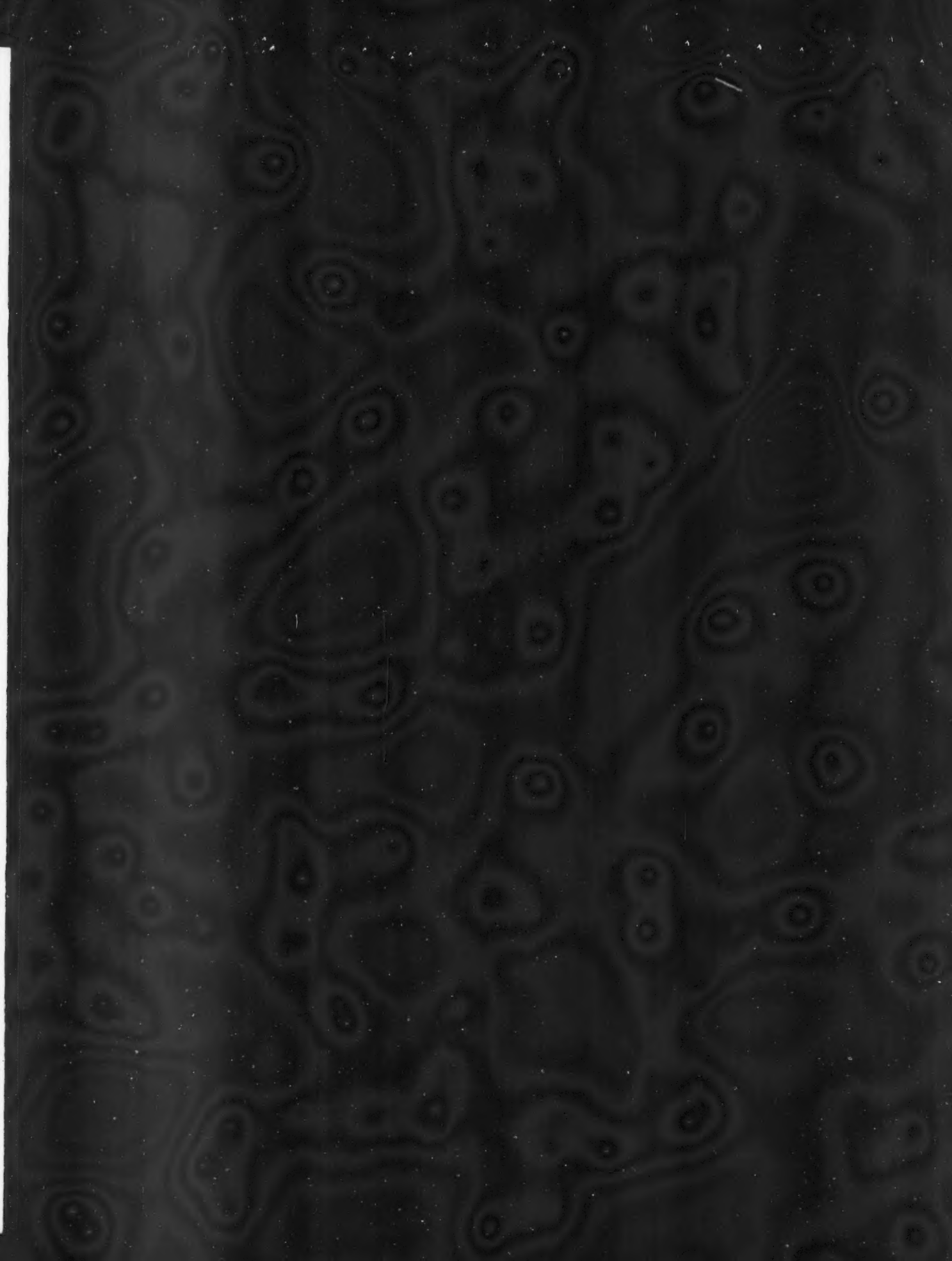
SUPERVISOR—Hello! Hello! Do you wish to call a number?

COLORED MAN'S VOICE—No, sah, Miss, ah don't want no numbah.

SUP.—Then don't play with the telephone.

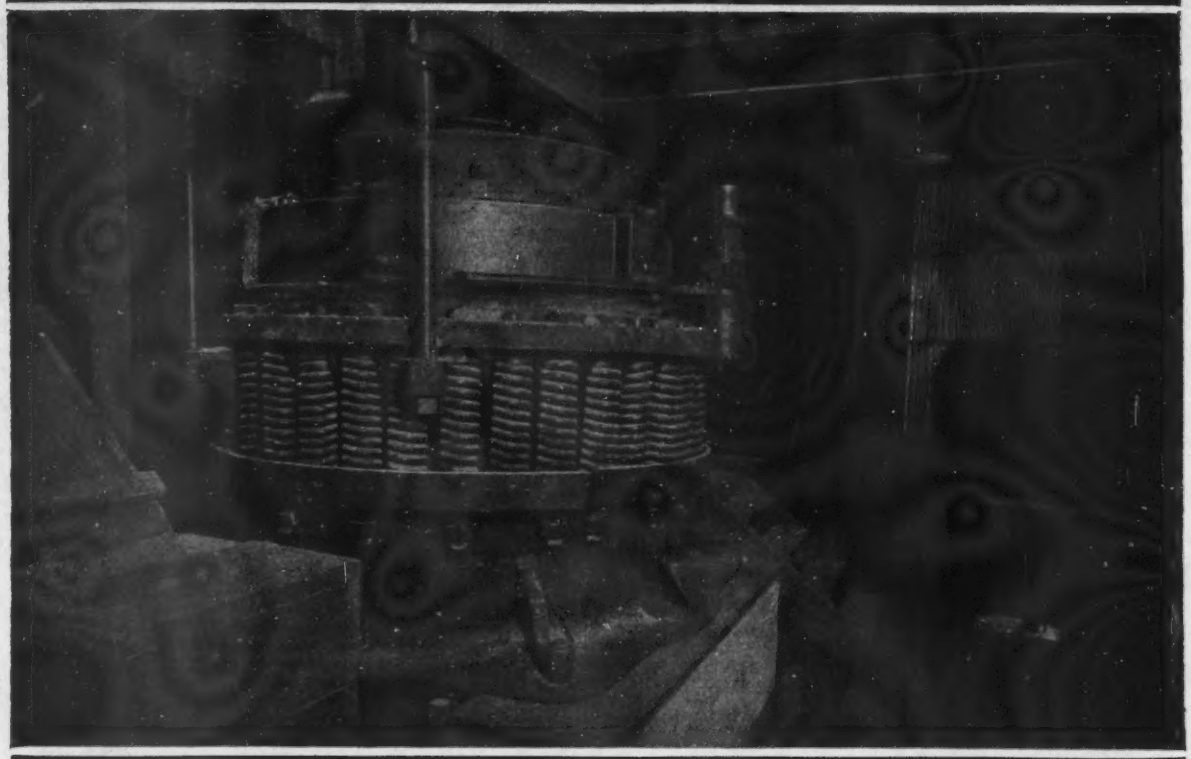
MAN—Ah ain' playing wif no fone. The receivah fell in de sugah bowl an' I'se been lickin' the sugah offen de receivah.

—*Printer's Ink*



Wherever Reduction Crushing is Done

SYMONS CONE CRUSHERS



Christmas Copper Co., Christmas, Ariz.
Four Foot Cone Crusher

Here is another example of a Symons Cone Crusher having been chosen where big capacity, a uniformly fine product and large ratio of reduction are desired. Their performance day after day is proving conclusively that they are without equal wherever reduction crushing is done.

There are five sizes to choose from.
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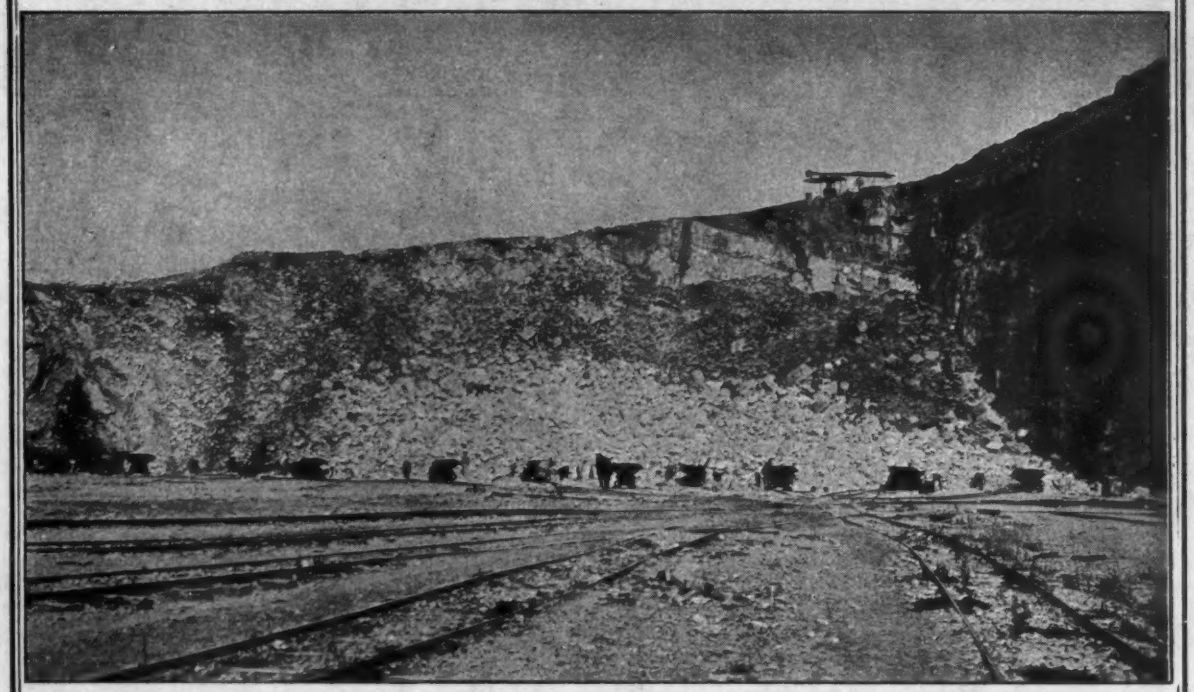

CORDEAU Helps Improve the Fragmentation

CORDEAU, by speeding up the rate of detonation of the explosive charges in a blast, adds materially to the shattering effect of the explosive no matter whether it is a high grade dynamite or the slower blasting powders. Rock well broken, toe kicked out, little secondary blasting, and crushing units well supplied with rock mean good operating conditions and consequent profit for the quarry operator.

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